

MAY 20 '59

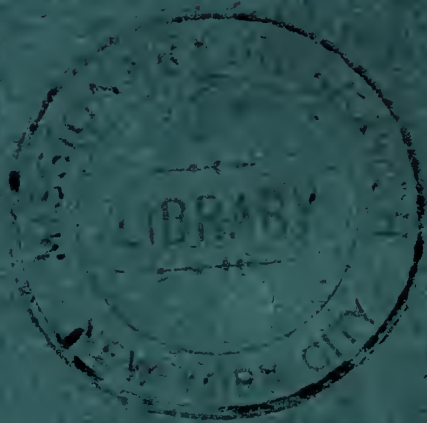
Simpson

To Our Friends

Wm. and Willard Simpson

Horticultural Experiment Station

East Cliff, Paitanbo Beach, China

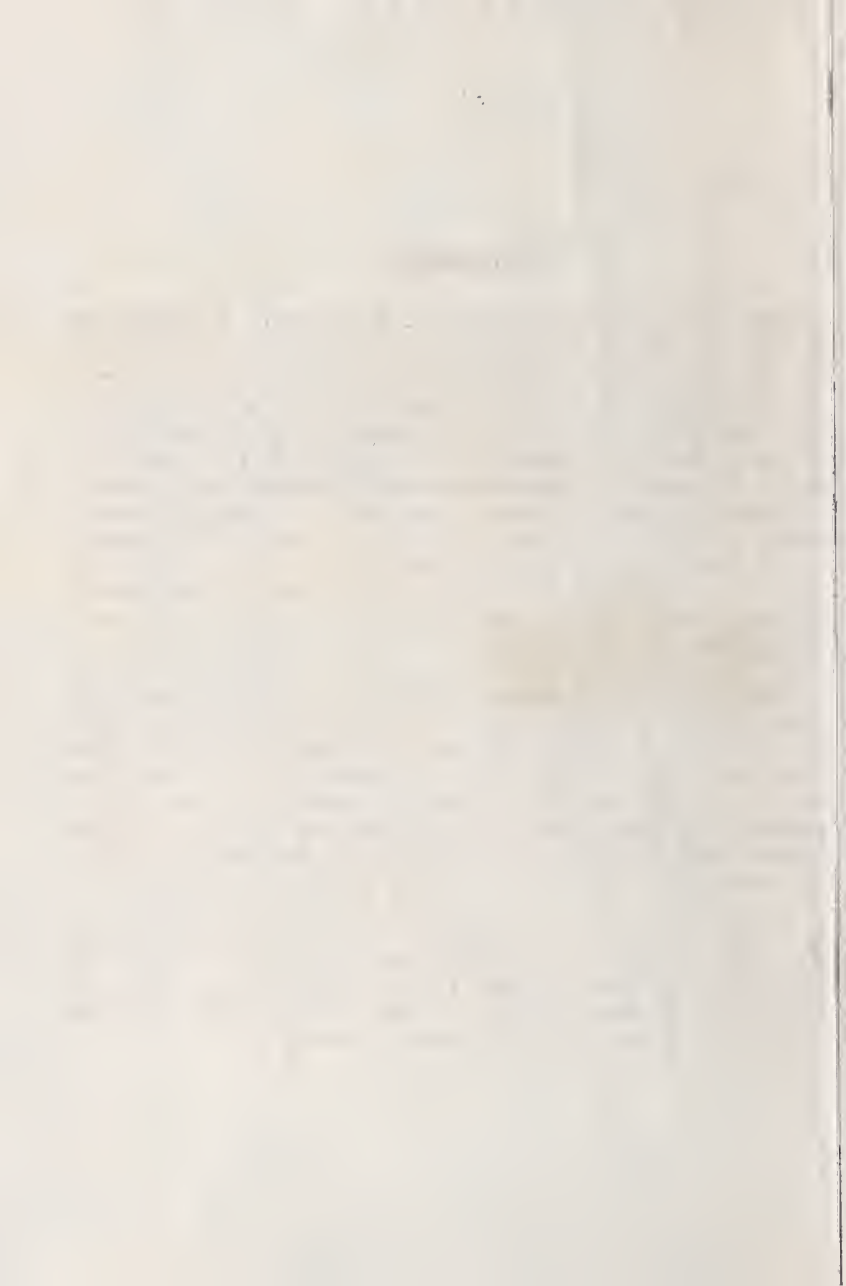


Introduction

These pages present an analysis of the agricultural situation in North China from the viewpoint of those who work in land reclamation and conservation. We wish to share the problem with our co-workers, which includes all who are interested in general agricultural improvement, and invite their co-operation in whatever ways are open to them. The suggestions here made have grown out of a study of the situation in different parts of China and also in several other countries, and the results of our own experiments in transforming wasteland into fruitland. Each year's work with the several types of barren soil in which we have been working has further convinced us of the possibility of a better outlook for the farmer if he can be helped to co-operate more fully with Nature in protecting and improving the soil.

This analysis in its present form is not ready to give to the ordinary farmer; certain parts of it can be easily translated into terms of his experience, but other parts will have to be presented and demonstrated by the better educated leaders in the various communities. The purpose of this paper is to analyse the agricultural situation in the light of scientific principles and actual experiments in the soil and to invite constructive criticism and suggestions from those whose experience would be of help in solving the problem.

We are well aware that mere analysis of a situation which is complicated by lack of fertilizer, food and fuel, and made worse by floods, will not accomplish much; but our experiments and those of others, including many progressive farmers, lead us to feel that there is hope for general improvement in agriculture.



HOW MAY CHINESE AGRICULTURE BE IMPROVED?

The task is not as simple as it appears to those who have not themselves toiled in the dust and the mud and faced the difficulties with which the Chinese farmer contends. Through long experience he has worked out methods to fit the conditions under which he lives, his greatest handicap being a climate that ranges from drought at planting time to floods at harvest. It is safe to say that the farmers of no other country could come into North China with its climatic extremes of winter drought and summer flood and do better than he does; for he plows, plants and covers the seed with such skill that there is a minimum loss of soil moisture. He also applies the limited amount of fertilizer so that it will be most available to the young plant.

What help, then, have we to offer the farmer? The results of experimentation in many countries, and the experience of many farmers, — many of them Chinese, who have learned how to cooperate with nature in the use of the land. A large part of our task is seeking, testing and adapting methods that have been discovered in different parts of China or other countries, and recommending those that promise to improve the situation. Fortunately we have the help of experimenters throughout the world, for many countries are truly interested in helping China, and are glad to share their discoveries, even their new varieties of fruit. When we have tried to thank these men for the help they have given they have assured us that they are glad to do anything they can for China, and more than one has expressed an appreciation of the many valuable plants that China has given to the world.

So splendidly have the countries of the world cooperated in the improvement of agriculture that it is now hardly possible to say that a new variety of plant or tree belongs to any certain country, for several countries may have helped to produce it. The Elberta Peach, for example, was first taken from China to England, and from there to America where it helped to establish the great peach industry of the southeastern states. In these different countries various improved strains have been selected, some of which we now have back in China, and it may be possible to make further improvements to suit conditions here. Thus has agriculture become a cooperative enterprise, not bounded by nations but extending throughout the world. The improved types of plants and animals have been produced by the tireless efforts of experimenters in many countries who are trying to make the earth yield more.

Agricultural improvement can be brought about only by experimentation,—thousands of experiments to determine what is best for the many different situations, but the farmer himself has a very definite part in this work. He must learn to experiment and test new methods and materials under the special conditions of his farm. Unless he does his part all the experiments of all the experiment stations of the world are of little value to him, even the experiments in his own country. He must learn how to try new methods carefully and be sure they fit his needs before he gives up the methods which he and his fathers have used for centuries;—to plant a small plot of improved grain beside his common variety and compare the two grown under the same conditions, or to use a new method of increasing the fertility of his land on only part of it until its worth is proven. He must learn to seek constantly for better ways of farming, not only from experiment stations but from his own experiments on his own land.

Cooperating With Nature

It is appropriate that any extensive agricultural study or discussion should begin with the soil, for the plant is rooted in the soil and from it are drawn very important plant foods. Although a great tree in producing all of the wood of its trunk and branches takes from the soil relatively only a small quantity of the plant foods,—for most of its bulk is produced with the help of the sun from the elements of the air and water, so necessary is it that these small quantities of essential plant foods be in soil and available to the roots that if they are not present in the right proportion the tree cannot grow.

The Chinese farmer recognizes the importance of good soil, to provide food for the plant and to receive and retain the rain. The land which he tills, however, has been used for so long a time that certain plant foods have been depleted and only by adding fertilizer for each crop can he hope to reap a harvest. Unfortunately, his supply of manure and other available fertilizers is insufficient and the yield of his land is much lower than might be expected from good land. This deterioration of the land has taken place over a large portion of the world and still each succeeding generation takes its food from the soil with little regard for the chances of future generations which must be fed from the same soil.

A careful study of the earth and its creation reveals a plan which should make the soil increasingly more fertile if only man would cooperate with Nature. When plants are permitted to grow

undisturbed by man they die and return to the earth, adding to it the organic matter they have built up from the elements of the soil, water and the air. Thus it is that grass or trees build up a rich black soil. Even on bare rocks, Nature can produce soil if given a chance. First she covers them with moss, then grass, and finally shrubs and trees, but the process requires a long, long time without interference from man or other destructive forces. In this way forests developed on rocky mountain sides and built up a rich forest soil but man has destroyed most of the good forests of the earth and interfered in many places where he should have cooperated with God's plan for the earth.

China is an example of the fate that befalls a land when its forests are destroyed and the soil that once covered its hills is carried down to the plains in devastating floods, but America and some of the other new countries are fast becoming even more terrible warnings of the results of man's disobedience to the laws of nature, for in these countries within one or two centuries man has lost the fertile soil that the prairies and forests had built during the ages past. Man must cooperate with the Creator better in the future than in the past if his descendents are to be able to live upon the earth. He must use every opportunity to stop the destruction that has begun, and improve the land, if possible, for future generations.

Switzerland is a splendid example of soil conservation on mountain slopes. Although the country has very little level land, by careful use of trees and grass she has protected the soil from erosion and supplemented the yield of her limited cultivable land with the products of her forests and pastures. If she were to destroy her forests and her meadows, within a few years her plight would become worse than China's, for the heavy rains would tear the soil from the mountains and bury the narrow valleys.

Grain Farming and the Need for Food

The conditions here in China, however, make it difficult to devote as much land to forest and pasture as is possible in some countries. The main yield of the land must be grain for that is the basic food for the millions who must be fed. So great is the demand for grain that little can be spared for animals. With the concentration of people in cities the food produced in large areas, even at distant points, is brought to them; and a small part, even of the waste products of the crop, is returned to the land that produced it. The straw and even the roots are burned for fuel, so that of the annual gift of Earth to Man, very little returns to restore the

fertility of the soil. Can Man expect Earth to continue indefinitely her gift of food?

But with the demand for grain as it is and the shortage of food, neither a farmer nor the country as a whole dares to turn much of the grainland into other uses, even though farmers in many sections do not make the expenses of their grain crop if they count labor, seed and fertilizer. If only they could find some way to provide more fertilizer, they say, and thus get more grain from their seed and their labor, but how can they?

One hope for improving agriculture lies in the use of improved varieties of grain. If these produce a little better harvest, it should enable the farmer to feed more or better animals. These by their work and their manure should improve the land so that with selected seed it should continue the higher yield.

It is urgent, however, that the general custom of growing almost nothing on the farm beside the crop of grain be changed. The grain crop presents an unbalanced demand upon the soil, and furthermore, there is a total loss of income in case the grain crop is destroyed by drought or pests. The available farm labor is poorly distributed for it rushes the whole family at special seasons of planting, hoeing and harvest but leaves them idle during much of the year, and since the only income of the farm is the grain, the year's labor must all be charged against it. Whatever amount of this idle labor can be used in other constructive enterprises, such as the reclamation of wasteland, reduces the labor-cost of the grain crop by that much. The growing of fruit and vegetables is of greatest importance in this situation for they are needed to supplement the usual diet of grain, and they help to distribute labor throughout the year. They also help to balance the demands made upon the soil and may sometimes give a crop when the grain crop fails.

Fertilizer Lost In The Fire

Perhaps the greatest obstacle to agricultural improvement in this country is the fact that while the farmer deplures his poor soil, he continues the practices that have impoverished the land. During the fall and winter the fields are raked again and again until every leaf and stem and root is removed for fuel. It is the occupation of the poor, — men, women and children, — between the autumn harvest and the spring planting, and one of their few sources of income. It is also, to a large degree, the fuel supply for warming the houses and cooking in many areas. In many communities it is the right of the poor to rake any field after the crop has been harvested

though in some places the farmer may protect his land from it, but usually only by raking his fields himself.

The custom of raking is a good one if all the material obtained thereby were converted into manure. It is claimed that burning destroys the insects and their eggs, but most of them can also be destroyed by the process which should be used in converting the straw and leaves into manure or humus. Experiments now under way show that this material can be turned into good fertilizer and the methods will be described just as soon as enough experiments have been made. In many cases the farmer could well afford to buy the straw and leaves, after they have been raked, to convert them into fertilizer instead of burning them. This will necessitate some other provision for fuel but that also is possible. At present all the ashes from the grass and leaves are saved for fertilizer and because the farmer knows they are good for that purpose, he fails to realize that the nitrogen, one of the plant foods most deficient in his soil, has been given off into the air in the burning process. The burning of leaves and grass means a tremendous loss to agriculture from the standpoint of soil fertility, but the loss is probably even greater from another standpoint. Decayed vegetable matter, generally known as humus, is needed to maintain the proper condition in the soil for plant growth. One may supply the necessary plant foods by using chemical fertilizers but they do not produce a good crop unless there is a supply of humus in the soil.

Importance of Humus In the Soil

The long continued practice of burning straw and leaves has robbed the soil of humus until it is difficult to keep it from becoming hard and cloddy. The amount of labor used each year to break the clods is a great expense for the farmer and much of it could be avoided if his soil had plenty of humus. The surface packs hard as it dries and much of the water of the next rain which should be taken into the soil and held until needed by the plants in drier weather immediately runs off and helps to cause floods, which carry away the good soil. Perhaps in no country on earth is it more important that the soil be kept porous, to receive and retain the heavy rains of summer, not only to reduce the floods, but also to supply moisture for autumn growth, and even for the next year. In a dry spring planting season the amount of humus in the soil may determine whether or not a crop can be planted at all until the rains come. One may find adjacent fields, one in which the land has become hard and cloddy through lack of humus and is

too dry to be planted, while next to it is a piece of land that has had plenty of humus added with the manure to keep it loose and free from clods and surface crust, so that it has retained enough moisture to be planted at the regular time and to keep the plants growing till the rains come. The advantage of having good land in such a season may be enough to give its owner a harvest when the poor land gives none. Then it becomes evident that nature's plan of returning part of the plant to the soil to keep it in condition is one that cannot be disregarded without heavy loss for the farmer and all who are dependent on the yield of the land.

It is easier to analyse the situation, however, than to remedy it. The need for food and fuel, and the force of old customs makes it a complex situation which must be worked out with the cooperation of the individual and the community; but, however difficult it may be, it is the only hope for relief from the menace of flood and drought, and general lack of proper food.

Hope In the Waste Lands

In different parts of China and in other countries are being worked out the elements of a great plan which, if they can be fitted together properly, should make it possible to improve the soil and at the same time to produce not only a greater quantity but also a greater variety of food. While part of this change must be brought about by a better management of the land now growing grain, a large part of it can be accomplished by the use of waste lands. Trees and shrubs, if properly managed, can bring much of this land into condition for even a higher type of cultivation and make it produce some of the fruit and vegetables that are so lacking in the ordinary diet. The shortage of lumber and fuel can also be partly satisfied by the trees and branches that may be thinned each year. Even greater than this is the part that trees and shrubs may play in building up the soil of the country and making it yield more food, for their branches can be burned instead of the grass and leaves, which are needed for fertilizer and to enable the soil to absorb and retain the summer rainfall.

If one talks of using the wastelands of China, he may be told that there are none, that no country on earth is so intensely cultivated. Granted without argument that most countries have more of this type of land than China, but China's population demands that every square foot of land be productive and, furthermore, the very needs of that population for food, fuel and remunerative labor make it more feasible than in most countries to transform every possible

bit of low-producing land in order that it may save her rather than destroy her. It must not be forgotten that much of the hard bare land,—not only the vast eroded hillsides, but also the small pieces of land bordering roads, streams and fields, which in total are enormous areas,—are not only unproductive, but, worse than that, it is this land from which rainwater drains so fast that it complicates the flood menace and carries the good land from the fields.

If one doubts the extent of these wastelands in North China, let him try making a map of any rural community with which he is familiar, plotting all the soil surface. Provide several colored pencils so that the contrasts will stand out. It should be a splendid exercise for a class in school to make such a map of the community.

Show the villages and the trampled land about them; part of which is necessary, of course, for the coming and going of men and animals. Show all the roads and the bypaths that cut in many directions across the fields. We must have villages and roads and paths, though there is a question whether they need to occupy so much land. All this might be shown in brown or black.

Then show in blue all the water-ways, from the rivers that flow the year-round, to the gullies and ditches that carry the summer torrents, and the hillsides and banks that are so washed by water that they are bare. Also show the great basin lands which flood so that crops planted in them are uncertain.

Next, mark the fields in red so that their location and extent may be clearly seen on the picture, being careful not to include the borders of the fields which produce nothing but scattered grass.

Cemeteries and all lands now growing trees may be shown in green. Then apply green to the field borders, the hillsides and all the part that has been colored blue, for that land should all be planted to trees or shrubs. The borders of the roads and the paths and the wide spaces near the villages should also be colored green, for this land could grow hardy shrubs even where large trees might interfere.

Now compare the amount shown in red with that in green and it may be surprising how low the proportion of red is in most communities; that is, how little of the total land area in square feet actually produces food. There are communities where this is not true but in most places there is a surprising amount of green on the map, which indicates land that should be growing trees and shrubs, and if this is compared with a map of the trees and shrubs

actually growing it shows how many more trees could be planted without decreasing the grain land.

Forestry and Trees

Qualified foresters say that it would be difficult to reforest North China. Once forests are destroyed, as they have been here, the porous, moisture-holding soil so essential to forest growth is soon lost and only by a long process can it be rebuilt sufficiently to produce forests of high quality. We cannot expect to be able to plant the best forest trees on bare rocky hills and get a good growth. It is as impossible to grow a good forest without providing the conditions required by forest trees as it is to grow a grain crop without proper preparation and cultivation of the soil. When nature establishes a forest on bare soil she does so by several successive stages;—study the appearance of trees on a sandbar freshly made by a river. First come weeds and grass and such trees as willow and poplar, and only after these have provided shade and their leaves and roots have built up a good soil do the better trees appear, even on moist river land. There is no hope of establishing forests on dry rocky land unless it be by some such preparation as nature makes;—a pre-forest of hardy trees and shrubs whose roots can tunnel into the deeper soil and crevasses of the rocks and make passages to invite the deeper penetration of moisture and of other roots after the pioneer roots have died. The real question, however, is not whether it will ever be possible to produce first quality forests, but how to use trees and shrubs to meet the needs for lumber and fuel and to serve the many other functions to which Creator ordained them, land-reclamation and conservation being most urgently needed.

The best trees and shrubs for land reclamation are the legumes, related to the beans and peas. By means of nodules that grow on their roots, they are able to obtain nitrogen from the air, and thus succeed on poorer soils than most other trees. Farmers are familiar with the nodules or lumps on the roots of beans and while they may not know the science of the process they do know that soy beans can grow on land that would not produce another crop. Planting leguminous trees and shrubs as a pre-forest crop is simply an application of principles which have long been used in grain farming. Several countries are beginning forestry work along this line and such reports as are available recommend the plan.

One difficulty has been to find trees that exactly fit the needs. The tree must be hardy enough to succeed in very unfavorable

situations, and yet it is essential that it may be controlled, even eradicated after its work is done if it is to be followed by better varieties.

The foreign locust (*Robinia pseudoacacia*) has been widely recommended and used but because of its sharp spines and the difficulty of controlling it some of its real values have been overlooked. It may be grown on rocky land where most other trees would fail and in the course of a few years its roots will have spread in every direction, opening channels through the soil and rocks. It is sensitive to floods so it should not be put in places where the land is submerged for any long periods. It is worth using on all waste places where it may spread without interfering with other crops. Even if it does spread, it may be cut back each year and furnish a good supply of fuel and its leaves may be fed to animals. If only a variety could be developed without the spines its prolific growth would not be objectionable for there is good use for every leaf and branch it can grow. Inquiries in several countries regarding the reported spineless variety have thus far failed to discover it, but in time we may be able to get one.

The albizzia (called mimosa or Jung hua in North China) should be planted in much greater quantity, for it is easily controlled, adapts to different soils and situations, has a good wood and beautiful flowers, and its leaves may be eaten by people or animals. Its abundant root-nodules enable it to grow on poor soil, and should make it a good tree to plant in among fruit trees to lift the winds above the orchard. Poplar is frequently used for this purpose but it is not a legume and it makes heavier demands on the soil than the albizzia. The poplar also uses more of the soil moisture in the spring when it is needed by the fruit trees, for its leaves appear early whereas the albizzia leaves do not develop till about the time they are needed to protect the fruit trees from hot summer sun and beating rains. Our experiments show that by proper pruning the albizzia can be made to grow very rapidly until it is higher than the fruit trees, when it may be permitted to grow a dense canopy of branches for windbreak. Other experiments now under way indicate that it has further uses which should make it one of the most valuable leguminous trees.

The Chinese locust, or pagoda tree is a good legume to plant in larger numbers wherever it can be given a long time to develop. It grows slowly but its wood is very hard and has many valuable uses. Its main defect is the fact that it harbors many kinds of

insects in its wood and its leaves, while the two trees described above are almost free from insects.

Although they are not legumes, the ordinary willow and poplar are good for planting along streams and in flood lands, but they should be planted much closer together than one ordinarily sees them, to make them grow straight and tall. Alternate trees may be removed after a few years to leave more room for the ones that remain. Thick planting helps make full use of the land from the first and produces a much better tree than the twisted, crooked ones that are scattered through the countryside. If all the groves in this part of the country could be fully stocked with straight trees that alone would double the available lumber without using additional land. Study carefully some of the thickly planted groves that are occasionally found on land that would otherwise be wasteland, and compare the amount of branches that may be removed each year,—to the benefit rather than the detriment of the trees,—with the amount of grass and weeds which the same land would produce were it not in trees. Usually the fuel value of the branches is greater than that of the grass, and in addition the trees continue to grow into lumber, and meanwhile serve to break the winds and prevent erosion. The leaves which are produced each fall can be used for fertilizer. Experiments are now under way to work out methods to make these half filled groves more profitable, for at present the scattered trees are occupying the land with too little return.

Pines and arborvitae should be planted in most of the cemeteries and in other places where their growth does not conflict with the crops of adjacent land. Arbor vitae makes a splendid windbreak around buildings and orchards and may be trimmed to make a good hedge or fence.

If walnuts, chestnuts and other food-producing trees could be planted in much larger quantity where they can be grown they would furnish a type of food which is greatly needed and in addition would eventually be valuable for their splendid wood. Walnut wood supplies a carving industry in some parts of China and gives a remunerative home industry, at the same time strengthening the love of art and appreciation of the beautiful. Much of the wasteland under discussion could be built up in a few years to enable it to grow some of the better forest trees, and nuts, and even fruit.

Leguminous Shrubs

Probably the best plan for improving the wastelands lies in the use of leguminous shrubs which by their ability to make use of

the nitrogen in the air have the advantage of succeeding where other types could not. They require less time to develop than trees and neither their shade nor their roots encroach so badly upon adjacent land. If properly managed they can greatly increase the fuel supply so that the leaves and grass may be used for fertilizer. If all the wasteland along roads and paths, watercourses, and around fields could produce a crop of straight stemmed shrubs that might be cut to the ground each autumn and used for fuel or baskets, it would be a most profitable use of wasteland.

Among the large number of leguminous shrubs in China and in other parts of the world there should be some to fit into these situations and the important task at present is gathering them together and testing out their special uses. They must be easily propagated, and yet not become a weed. They must not conflict with crops planted near them; this is especially important during the drier part of the season when soil moisture is limited, and yet one of their functions should be to assist in taking up the abundant moisture of the rainy season. They must also be able to grow in land that ranges from very dry to very wet and from pure sand to rocky clay. It is highly important that they should not breed insects or diseases which would affect them and spread to other plants. Their uses must be such that they can repay whatever labor is needed to establish and care for them, either in yield of fuel, basket wood, animal food, flowers for bees, oil or other products, and the production of nitrogen gathering nodules should be heavy.

Amorpha

Several years ago we set out to find shrubs to meet these requirements for it is evident that trees are out of the question for planting in many places where shrubs could be used. This search has been carried around the world and we have found several that look promising for situations and purposes. It seems like an answer to prayer, however, to have found one which thus far meets nearly all of the qualifications listed above, and we only hope that it will fulfil the promise it now offers. It is the *amorpha fruticosa* and though it is found in Europe, America and Asia, there are few records of it having been used as fully as it may be by proper management. Although it is used to some extent to the north of the Great Wall of China it is not even reported among the shrubs growing south of that boundary except in places where it is cultivated as an ornamental; yet it seems to thrive in the several provinces of North China where it is now being tried.

It can be propagated by seeds, roots or cuttings and to get a good growth it must be cut to the ground every year or two. If not cut till the second year the branches bear a profusion of deep purple flowers with gold stamens, the flower-spikes covering the bush in June like numerous purple candles at the end of each branch. If one judges from the number of bees that swarm about the flowers it is good bee-food, coming at a time when other blossoms are not plentiful. There are records of a good quality of oil having been extracted from the leaves and also from the seeds but no information is yet available as to the use of the oil or whether it can be profitably extracted here. Since insects have not infested the plant it may not be too much to hope that the pungent odor of all parts of the plant might make it of value as in insecticide. This same odor probably accounts for the fact that thus far grazing animals do not appear to like the leaves,—a point of tremendous significance in establishing it in certain situations.

The *amorpha* has a very heavy yield of small root-nodules, and succeeds on poor soil though it does not grow there as vigorously as on good moist land. Its long heavy roots withstand torrents of eroding water and it does not suffer from being flooded, which makes it valuable for planting in watercourses and floodplains. It takes two or three years to become fully established, after which the annual growth of the dozen or more shoots ranges from five to eight feet on good soil, providing it is cut to the ground each season. Several hundred which were planted on slopes of almost pure sand have survived with almost no loss but the growth during the two years since planting has averaged only about two feet. However they might be able to build up sand-wastes even if they do not grow so high. Whether they will become more vigorous later and if so what part inoculation experiments may play remains to be seen. It was the need for a leguminouse shrub which might be used in sand as the Chinese farmers use willows and mulberry that set us off on the search for these shrubs to improve soil by their root nodules, and we hope the *amorpha* may prove satisfactory. It is quite possible, however, that we shall find others that equal the *amorpha* for certain purposes, for the search and experiments here merely begun. Just why the *amorpha* has never been used to the extent that our results with it would justify is not clear unless the fact that it must be cut to the ground each year to get a good strong growth may have concealed its values when well managed. To date it appears to respond equally well to autumn, winter or spring pruning but we

may find that pruning at one season produces better growth than that at other times. The relation of blooming to weaker growth and also the response in climates which may be less favorable to heavy summer growth than this one are also factors that remain to be studied.

Although we may find other shrubs equally good for the various purposes, it is convenient at present to use the *amorpha* to show the type of shrub planting that needs to be done in this country, and we will use it as an example both in description and in actual demonstration plots. Within the next year or two we hope to have such a plot at our nursery at Tunghsien, near Peking, and one at Peitaiho Beach, where we will try to show in a growing picture what shrubs and trees can do to reclaim, protect, and improve the different types of wasteland we have been discussing.

If all the roadsides could be bordered with a shrub like this that can be cut to the ground each autumn it would help immensely in maintaining good roads, in addition to being a good use of the land. Everywhere we hear of the necessity of building good roads but once they are built they are usually damaged by the heavy rains that first wash down the edges and then tear out the center. If roadsides were well planted with *amorpha* they could resist much of the damage that now occurs.

Many of the paths could also be bordered with this shrub, for it grows so straight that it does not require a great amount of space to produce its tall, smooth stems. It might also be planted directly in some of the paths to block traffic from them, for there is a heavy loss of good land through the carelessness of men and animals in making so many paths.

Amorpha has been used by the Chinese farmers outside the Great Wall to divide their fields and in our tests of it in the garden and in the orchard it has not seemed to interfere with adjacent plants, notwithstanding its heavy root system. For planting in field borders it is advisable to use a leguminous shrub, and one that does not begin its heavy spring growth till rather late, for thus it makes a light demand on the soil moisture and fertility in the early spring. *Amorpha* shows promise of considerable value in this use; what would it mean if most of the fields were bordered in this way? Not only would it mark field boundaries and use the strip of land that is now idle, but if the fields were leveled and then bordered with shrubs it would greatly decrease the loss of good fertile soil that is now carried away with each heavy rain. The annual loss of this topsoil

is one of the greatest calamities the farmer endures for it contains a part of the insufficient fertilizer he has been able to provide.

By weaving the long straight shoots as they grow into a fence, we have found it possible to use this shrub as a border for garden or field. If a permanent fence is wanted the shoots on the inner side and those on the outer side of the row may be cut in alternate years, leaving half to form the old fence until the new one grows.

If all the cemeteries were planted with trees or shrubs it would work a transformation in this country. Someone has suggested that a planting of these beautiful shrubs which can be cut to the ground each year would be appropriate in all cemeteries and would greatly lessen the necessary care of the graves, for the long branches would protect the mounds of earth from washing during the summer.

Think what it would be worth if all the watercourses, from the winding flat river-basins to the millions of ditches and gullies which lie barren from one flood season to the next could be straightened and planted with *amorpha* so that the water would clear its own channel but occupy only a fraction of the land it now wastes! Then if all the flood plains which the waters must cover in time of excessive rain were planted with this shrub they would help to hold back the floods and make the water deposit its burden of stolen earth. It would not be safe to claim that all of China's floods, with their accompanying misery, could be averted by tree planting, but many of them are caused by the unhindered flow of water from the slopes just as fast as it falls. Every obstructing tree and shrub delays the rush of water by just so much in reaching the common channels and by that delay more water is given time to soak into the ground, thereby reducing the flood by that much. Road and path borders, field boundaries, and watercourses all planted with shrubs would save the country from at least part of the floods that now occur. In addition if by the increase in fuel from their branches, their leaves and all grass now burned were put into the soil as humus, much of the water that now causes floods would find its way into the soil to be held till needed by growing crops. Add to this the increase in available fertilizer that could be secured from all the leaves and grass and there would be much brighter hope for agriculture and the livelihood of the people.

A further and most important use for *amorpha* is in the improvement of wasteland so that it can be planted to forest, nut or fruit trees. In several years time it should be possible for its roots to open up and improve the soil so that the desired trees would

have a better place to grow. Since amorpha can be cut to the ground each year, forest trees may be interplanted among the shrubs, which in this use should not be cut back till late each spring in order to give winter protection to the young trees. Since the new shoots of amorpha do not start till late, most of the soil moisture and sunlight is available to the young trees until summer when the young amorpha shoots are high enough to protect the little trees from intense heat and heavy rains, and to provide the ground cover that is important in developing a forest soil. Since the shrub never grows higher than ten feet it is possible for the young forest to rise above it in a few years. This will probably not kill the amorpha for it endures shade and in many cases can simply be left to grow under the trees. Since the need for the shrub to plant in other places is so great, however, it may be wise to dig out the amorpha roots after the forest is well established and use them to start new plantings. Fortunately this can be done in the summer rainy-season when holes can be dug with the least labor, for amorpha transplants well at that time. All the available grass and leaves should be buried in the hole from which the shrubs are taken, to rot into fertilizer for the trees. Aside from the use of some such pre-forest plan such as outlined above there is no hope for growing good trees on much of the land that should be in forest.

Can It Be Done?

If the question arises, when and how can this program outlined be accomplished the reply is that it will not be done in a day, nor completed even in a lifetime; but that it can be brought about whenever enough leaders and communities see the need and the possibility of improving the general agricultural situation.

Part of it can be done by individual farmers without waiting for the community, as they transform their own small pieces of non-productive land. We have found that the best way to help a farmer discover how much wasteland he has is to make a rough map of his place,—it may be scratched into the dust of the roadside using a stick for a pencil. Count the needless paths, the field borders and the gullies, cemeteries and unprofitable hillsides. After the number of square-feet of wasteland on his farm has been discovered figure the amount of fuel or material for basket-making it might grow; and if it could be developed later to produce nuts or fruit, what yield might be expected. Ask him how much manure he is able to prepare for his land each year; and then ask if he could use more if there were

more available and watch his surprise that you should ask such a foolish question! Finally, study the cost of thus improving his general farm situation and help him to realize that it can be done with very little expense other than his own labor during his spare time.

The best time to do this work is during the rainy season, after the wheat has been harvested and the other grain no longer requires cultivation. With plenty of moisture in the soil it may then be dug to a great depth with only a fraction of the labor that would be required at a drier season. Care is needed to prevent the fresh-turned earth from washing away during heavy rains but this is possible by leaving a protecting ridge about the plot and also by burying grass and weeds, even small branches of trees, which permit the rainwater to enter the soil without washing it away. With plenty of moisture and warm days, the green leaves and branches quickly decay and provide some fertilizer, and leave passages in the earth to encourage root growth of the trees when they are planted.

In one of our experiments trees planted four years ago in hard clay soil in which weeds and straw had been buried have now grown ten times as tall as the same kind of trees planted two years earlier in an adjacent plot where the soil had not been dug up and mixed with vegetable matter. The difference is only partly due to the fertilizer provided by the straw; this clay is so hard except during the summer that it is difficult for the roots to penetrate, and it is too deficient in air and moisture to properly feed the tree. On the plot where the straw was buried there is more moisture and air in the soil throughout the growing season.

If a few farmers in each locality will work these experiments on their own farms it will help to determine what can best be done in their respective communities, for as was stated at the beginning of this discussion, the best plan for each locality must be worked out by the people themselves. The answer to the objection that it is not possible to secure the necessary cooperation in the average community to carry through this program is that there are some communities that are wide awake, with leaders who are willing and able to experiment in seeking an escape from the present lack of fertilizer, food, and fuel, and the damage of floods.

It is essential that the several parts of the program be carried along together; for increased tree planting may provide more fuel but only a part of the possible benefit to the community is secured unless the leaves and straw can be turned into fertilizer to increase

the yield of the land. Is it not worth the effort it will take to carry it through when one considers the values that may be brought to the community;—lumber, fuel, windbreak, road protection, hedges and fences, field-boundaries, a more beautiful country, flood-prevention, erosion control, moisture conservation, more fertilizer, and transformation of wasteland into groves and orchards? There is opportunity in this program for any community which will cooperate with its leaders to develop self-respect and character as they work with the Creator in helping to carry forward the creation of a beautiful, fruitful earth.



FRUIT GARDENS

The theme of this paper is the ultimate planting of as much as possible of the wasteland we have been discussing, with fruit trees or bushes. No other crop will give as valuable a yield of edible product, whether measured from the standpoint of quantity, cash value, or urgent need in the diet of the country.

If by thorough preparation of the soil and protection of the fruit-trees from wind, insects and other handicaps, a Chinese farmer can transform various unproductive parts of his land until they yield good fruit, he has accomplished something of value not only to his family but also to his country and he has begun to cooperate with the Creator of the earth to make it a more fruitful and beautiful place for man to live.

The discussion here does not apply to the planting of large commercial orchards involving a heavy capital investment and much labor outside that of the family. For such an enterprise the first consideration must be good land and a favorable climate, to guarantee an income worthy of the investment. Ten years ago the fruit-farmers in Changli fruit area claimed that fruit should be planted only on the hill-land for the grainland was too valuable to use for fruit. Each year, however, there have been more of the large plantings down on the grainland, even though the hill-planting continues on a small scale. Some of the best fruit in the Changli hills is grown on soil that has filled in behind stone walls built across ravines to catch the eroding soil and gravel; — sometimes these filled-in ravines have a great depth of soil and the trees respond wonderfully to the deep rootage.

If one counts the number of square feet of wasted land in Chinese court-yards and mission compounds, next to buildings and paths, in gullies and ravines, and on slopes unsuited to grain-growing, — the total amount runs into staggering figures. Then remember that some of that land could grow good fruit, and that ten square feet of suitable land in a fruit-garden is enough for a large berry bush, and a hundred square feet for a fruit tree. From this may be gained some idea of the opportunities to produce needed-fruit which are now being wasted, and much of it could be grown with labor which is now idle during part of the year. Under present conditions the investigations which have been made by one of the universities show that the farmer is relatively idle during more than half of the year and one of the greatest needs is for him to engage

in productive labor during more of the year. Since all of the work we are urging could be done by this marginal labor, it is clearly one of the ways for improving the rural situation.

These statements represent our conclusions after five years' work on the barren eroded valley we have been trying to convert into orchards, and four years' work on the land about our home which was so unpromising that people laughed at us for trying to use it. When we began we hoped we might use thirty per cent of the valley for fruit; within two years we hope to have every square rod of it growing some kind of fruit. We are not denying that this has cost heavily in labor; — first, because we began with a very unpromising piece of land; second, we have had to try several experiments to determine the best way to use each type of land; and third, we have tried to hurry the work along as fast as possible so we could share the results of our experiments. In some cases where our results have been finally achieved after trying several methods, we can help others follow a more direct way than we were able to take. We are urging people to reclaim only the amount of land each year that can be done with the labor available, — a corner of a courtyard, or a gulley, and to do well that which is attempted.

In planning for fruit it is imperative that one study carefully the probable obstacles to success, and try to remove as many as possible. In the case of our own fruit garden we were advised, since fruit had been tried next-door and failed, that our exposure to the sea wind was too great. There was no depth to our soil, which was all ridges and gullies when we began on it, with rock exposed in many places. Our natural love for trees made us try, and we broke up the rock and terraced part of the land, even though we had little hope of success. By deep soil preparation and the use of kaoliang-stalk windbreaks until the trees planted for windbreaks are large enough to break the sea winds, we have been able to grow hundreds of berry plants and fruit trees to the present stage where they are giving us a succession of fruit throughout the season. Of course we will have to deal with other obstacles from year to year, insects being the most difficult at present, but there is hope for even a better control of these than we have hitherto obtained.

The importance of a careful study of the situation, and an earnest effort to discover and remove difficulties must not be forgotten. Sometimes a single factor determines success or failure. In South China we visited a village which is reported to have become tremendously wealthy from its fruit, for they divised a simple

method of keeping the oranges till the market called for them at a high price. But an equally important factor in their success was the fact that the trees that covered the near-by hills had been permitted to stand for wind-protection, whereas most of the country we saw was hilly land as bare as ours in North China.

In the apple country of Washington we studied an orchard where the trees were bending down with the most perfect red apples I have ever seen or tasted, many of them weighing a pound each and growing in clusters. Just across the road was the kind of land that had been redeemed to make this orchard, — dry sandy waste with scattered cactus and sage-brush. Several factors helped to produce these perfect apples, — sunshine, wind-protection, water, and deep, fertile soil. The provision of irrigation water was the factor that changed that wasteland into fruitland.

The finest oranges in the world are grown in Palestine on land that formerly was almost useless, if one can judge by the barrenness of the land that adjoins the beautiful orange groves. Some one discovered the factors that were needed to change this unproductive land into orange land, and produced a fruit of superior quality and size.

Here in North China we have sunlight and sufficient moisture in most places to produce beautiful fruit with a splendid flavor, but we must protect from wind and provide a deeper, more fertile soil. Most of the soil in this part of China has been impoverished by taking from it all the vegetable matter it produces and returning very little of it to the soil. Humus is very important to keep the soil loose and to enable it to take in moisture during the rainy season. It also functions in breaking up the elements of rock and hard soil, and making them available for plant food. We planted a large plot of raspberries last year in moist soil that is composed mainly of broken rock and decayed kaoliang stalks, and we expect them to grow luxuriantly, judging from previous experiments of similar nature. With the help of the kaoliang stalks they withstood a terrible flood that passed over them last summer, and it is to be hoped that in time much of our soil erosion control can be done with fruit-bearing bushes. Of course it is important to protect them from erosion until they become fully established and to provide drainage, if they resent an undrained soil.

After thorough preparation of the soil for planting, the next important factor is to secure the best variety possible. One can change to new varieties from year to year in wheat-growing, but

with fruit one should begin with the best he can obtain, though it is not impossible to change an orchard over to new varieties by regrafting.

We now have as fine a collection of new improved varieties as it has been possible to secure, and we hope not only to distribute those that succeed in China, but also to produce from them as parents new varieties to fit the special conditions of this country.

This year we have begun a new plan of distribution of trees, plants and seeds. The general success people have had in taking fruit trees and berry plants with them when they return from Peitaiho has encouraged us to offer by mail the varieties we have thoroughly tested and can recommend. It is easily recognized that danger of loss is greater in sending plants by mail than when they are carried by person who has bought them, so we have tried to bring the Chinese farmers to one of our nurseries to get their trees, where we can show them the results of our experiments and make sure they understand the needs of the trees.

We do not plan ever to run a complete nursery or seedhouse for our task, insofar as we can see it, consists in gathering together the best varieties, testing them and propagating only those that are worthy of our recommendation. This caution has delayed us in propagating large quantities of trees, but a study of other nurseries overstocked with inferior varieties has proved the advisability of such a course. This past year our first orchard of pears propagated from a variety we found worthy of planting began to bear. That orchard is a joy to us, both in flower and fruit, for it is a promise of what can be done in China with good varieties.

Of the two hundred varieties of fruit we have placed under test some will obviously fail to measure up to the standard, but if one fourth of that number should succeed it would be a great advance in the fruit-growing industry.

Due to the impossibility of knowing how many of a variety to propagate to meet the demand, we are beginning by offering collections. This will help us for it will enable us to include new varieties just as fast as they prove themselves and can be propagated, and it will also help the person who orders them if he is not familiar with the names of varieties. If this succeeds we can assist in a rapid distribution of reliable improved varieties at prices otherwise unobtainable, for we will reduce the prices on items just as soon as we dare, in view of the expenditure made to obtain these new varieties, and the need for funds to bring in new varieties each year. By the time

a new variety has been brought to China and tested long enough to know whether it is worth propagating and recommending, it has totaled a considerable cost to us (not to mention the cost to the experiment station or other agency which produced it) but part of its cost we can charge against the joy of having a promising new fruit appear!

Several years ago I brought a collection of different kinds of berries with me to China, carefully tending them all the way across the Pacific. Of the total number I had brought I saved only one plant, but that happened to be the best variety, the Youngberry, which is most promising for fruit-gardens and Chinese courtyards. After testing these thoroughly we offered them for sale at a dollar a plant, Chinese money, which is less than I had paid for the original plants. Now we are reducing the price on these to a dollar a dozen prepared cuttings, (most of which should grow,) which will enable the Chinese farmer to buy them.

Our Dollar-Collections this year will include the following:—

- A. Youngberry, Red and Black Raspberry, small plants of each.
- B. Strawberry, fifty plants of varieties we have tested.
- C. Grapes, a dozen prepared cuttings, including at least five varieties.
- D. Vegetable seeds, four varieties of tomato and lettuce we can recommend.
- E. Annual Flowers, collection of choice new varieties.
- F. Perennial Flowers, collection of recommended varieties.

Our five dollar collection this year will include:—

- G. A small orchard of ten fruit trees we can recommend.
- H. One hundred gladiolus bulbs in a fine mixture.
- I. One dozen dahlia bulbs, different kinds.
- J. Ten ornamental shrubs in choice varieties.

We are most anxious to see these new ornamental shrubs distributed, and while our stock of them is still limited, we will propagate them just as fast as we can for they should meet a real need in China. How many court-yards there are in which one or two very ordinary shrubs are carefully tended in anticipation of the few flowers that come once a year! The new varieties that bloom throughout

the summer or the ones with colored foliage as beautiful as flowers, — purple, golden or otherwise variegated, — these will bring joy to many people. We make no apology for working with flowers to the extent that we can without interfering with our main projects, for there is such a need for flowers to brighten the lives of these people, who love them.

The care given to a tree at the time it is planted may determine not only whether it lives or dies, but also the time that will be required for the roots to begin feeding the plant in a normal way. When roots are removed from the soil in transplanting, it is important that the branches be cut back or very carefully protected until the roots can take in the water needed by the plant. We always shade the plant and protect it from wind, unless the transplanting is done during cloudy rainy weather, and even then protection should be given if possible. A cone of heavy paper, a bunch of straw or a protection of small leafy branches cut from trees greatly assists the plant in getting established. Not only our experiments, but also those of experiment stations in America show that plants and trees can be transplanted at almost any time during the year if sufficient care and protection are given. The care given them in planting and afterwards, determines not only whether they live but, almost as important, how long it takes to bring them into healthy growth. A few days of neglect within a month of care will ruin everything. Each year we set plants that have been enroute a month or two and some of them look rather dead when they arrive, but it is surprising how well they revive with proper care.

Pruning and spraying are both important subjects that cannot be dealt with in a few words but the necessity for both can be greatly reduced by the attention and care that one can give to the trees as one passes by. It is much better to train a tree into the proper shape by pinching off the new branches that are beginning to grow in toward the center of the tree where light and air are limited than to wait till they have become large limbs and saw them out, leaving ugly scars. Insect control can also be done on a small fruit garden with fewer sprayings if one watches for and destroys the pests at their first appearance.

Seldom do we feel more deeply our gratitude to the Creator, not only for His world, but also for the privilege of cooperating with Him in continuing His Creation, than when the first fruits of some new variety ripen here in China, and show promise of an improvement over what is now grown.

Horticultural Experiment Station
East Cliff, Peitaiho Beach, China
Winter, 1937

Dear Friends:

It would be wonderful if you could be here at the seashore these sunny winter days to enjoy the changing beauty of the blue water with its gleaming shoreline of snowy ice, and the purple mountains beyond. And think of the visits we could have! We have greatly appreciated the letters and Christmas Greetings that the postman has brought on his twice-a-day call. We hope that these pages will make you feel that though we may be in different parts of the world we have not forgotten you and value the letters that come from you.

It was good to see you whom we did see during furlough, but we realized only after it was too late that we had tied ourselves so steadily to the work that our chance to visit with many whom we had hoped to see had gone by and would not come again for several years. All during furlough we were urged on by the fact that what we could hope to accomplish out here during the next few years depended to a large extent on our use of the opportunities during furlough to gather information and materials for our work. We returned to China with a fine supply of both,—thanks to the generosity of experiment stations and many people interested in the work we are trying to do, — but the furlough year and the strenuous first years in China have cost us physically, and we no longer try to work all day in the field and then far into the night at the desk. You may understand after you read this booklet why our letters have been so few; even this printed one has been three winters in preparation. I wish we could have sent the account of our trip through Europe earlier, but winter is the only time I can hope to work at the desk, and by the time the accumulated accounts and business letters are done, spring appears.

We are always glad to see spring with its flowers, even though it also brings long busy days out in the field. When the sun is lazy about rising we can be lazy and wait for him,—if Barbara is willing, which is seldom; but when Old Sol becomes energetic and climbs out of the ocean at four in the morning, I also have to appear, for our men begin at sunrise and I usually have to supervise the work. There is a great compensation for early rising, however, in the beauty of the dawn as it breaks over the sea and lights up the

mountains to the north of us. We sometimes feel a bit selfish to have so much beauty of sky, sea and hills, together with our flowers and fruit. One friend asked last summer how we survived such an abundance of the beautiful, and I replied that I fear we keep so busy we fail to see it all. We are thankful for the inspiration it brings. It is a privilege to look out over the silver-crested sea to the purple hills during moments of rest. Our labor is rewarded not only by the flowers and fruit but also by the assurance that the results of our work may ultimately be extended throughout the country. This lightens the drudgery and doubles our enthusiasm. We love our work, not only when it takes us into interesting new places, but also when it keeps us digging here in the soil seeking ways to help the country we are trying to serve.

Since our return from furlough we have filled the land about our home with experiments, hoping to show that fruit trees of the improved varieties, if properly cared for, can produce high quality fruit and also grow into a truly beautiful landscape. This has been especially difficult because of our exposure to sea winds. Each winter we have to prepare windbreaks, but in a few years the trees will give mutual protection.

We are thankful to have a home at last, without having to crowd in upon the hospitality of others. Just the freedom from moving about from place to place has been a great saving in energy. We are comfortable in our compact winter-quarters with plenty of sunshine and warmth, and most thankful for the chance to borrow money to put in a hot-water heating system, so we have day and night comfort even if the ocean is frozen out as far as we can see. We have two heated greenhouses so experiments can be continued the year round. I like my little study where I sit in the center and can reach shelves or desks on each side (just a little room of ordinary Chinese construction with the usual south window) but Alice says it is so full of ideas and things that she can't work in it. The work-room where the boys we have trained are now preparing seeds and the greenhouses are adjacent, so it is a real treat to get indoors once a year and settle down to these tasks. We now have our courtyard-garden glassed-over to make a cold-greenhouse where hardy plants stay green the year round. Our new greenhouse is sunken into the hillside next to the fruitcellar and this unit will be used for starting plants and hatching chicks in the spring, fruit-storage and experiments in the summer, bottling and canning fruit in the fall and storing our fine collection of bulbs and plants during winter. As

soon as winter breaks we will be working full force filling the green-houses with seed-boxes. The fabled winter rest for farmers has not proven true in our case, for there is always plenty to do, both for the men and ourselves. The very nature of our work here,—which is the transformation into fruitland of a valley which was formerly barren, eroding wasteland,—requires constant experimentation and supervision. Each new task depends on the outcome of previous work. When we have a dozen jobs going it keeps my head and feet working. I carried a pedometer one day and found I'd walked over seven miles without leaving our land.

It is as fascinating as one could wish, especially if one thrills with the possible values of all this use of the pickaxe in making the wastelands of China yield food. When we began on our valley we hoped that we might use thirty per cent of it for fruit; in two more years we hope to have every square rod of it planted. I no longer have to work like a coolie, as I did the first years in breaking up the land; the men now have faith in what we are trying to do and take hold splendidly, but we seldom start digging in a new place that I do not take the pickaxe and test the depth of the soil and the hardness of the rock beneath.

Even now, with the sea half covered with floating ice, we are able, thanks to the sunny days, to continue our digging by covering the places at night to prevent freezing, and thus give year-round employment to a limited number of men. One of the greatest needs in this part of the country is for a chance to work at profitable labor during a greater part of the year, for at present farmers average only about a hundred days a year. Our land reclamation program should help remedy this situation, first in the preparation of wastelands for planting to trees and shrubs, and then by the labor required each winter to cut branches and prepare them for fuel or baskets, and in the composting of leaves and grass for fertilizer. Here in our small community are a dozen men wanting to work for us at low wages, but we cannot afford it now though there is plenty of work that needs doing. Our financial situation is like that of many of the mission institutions;—a much smaller budget than several years ago and a greater work needing to be done. Undoubtedly it has made us cross from our list of projects the less important, insofar as we could estimate their importance without trying them, and it has helped us to focus on a few major projects, but like most of the missionaries we have experienced an added burden in choosing from the many needs involving the livelihood of the people we love, the few tasks we dare attempt.

As soon as this long delayed booklet is printed we hope to begin the organization of a series of five small books on Soils, Orchards, Gardens, Flowers, and Trees and Shrubs. We want to get them into preliminary form this winter and then test them for a season or two before printing and translating. The literature available on these subjects is very limited and consists mostly of translations of books written where conditions are far different than ours. The longer we work the more apparent it is that we can never know everything, so we had better tell what we know from our work thus far. Parts of the blue booklet we sent out four years ago have been published in periodicals in America and in China and we are glad to have them used.

Each summer brings many people to Peitaiho Beach who are just as interested in helping the country people as we are, though few of them can give full time to agricultural experimentation. They come for their vacations, but once they are rested many of them,—both educated Chinese and foreigners,—are anxious to discuss the problems of the area where they live in relation to the experiments we are attempting. They can watch our successes and our failures and adapt what they see to their conditions. This gives us a strategic opportunity here to reach out over a large part of China, and the discussions bring us many new ideas as well. The greater their interest the busier we are, but we are glad to be busy in this work. Since our experiments here have shown that plants can be transplanted during the summer rains with more safety than during the dry windy spring season, many people have taken new varieties of fruit and flowers with them on their return from Peitaiho. This method of extension greatly multiplies our opportunity to distribute plants throughout China, for it is a well demonstrated fact that any new plant that is brought into a mission station and proves successful is soon scattered throughout the community. Thus the gardens of missionaries not only supply them, but also serve as centers of distribution for new varieties.

Although we live in a seaside resort in the summer, it completely changes character when people leave and becomes a rather isolated community during the rest of the year. The past three winters we have been the only foreigners living here at the East Cliff end of Peitaiho Beach, which is two miles from the center where the railway station and the shops are located. Good train connections with the main line continue throughout the year but most of the shops close. Our Chinese neighbors walk to the market town six

miles distant to buy their supplies. We have learned to prepare food for the winter and to enjoy what we have. Providing food for our cows and chickens has become one of our financial problems, but we would fare poorly were it not for them, and we have been able each summer to supply people returning from the beach with good chickens to start flocks in their communities.

Alice has worked hard to prepare such foods as sauer-kraut, fruit-juice, cured-meat, butter, bread and a list of meat substitutes that can be made up from the native products. Out of our own problem, as so often happens, have come ideas that may prove helpful to others. She goes to Changli once a week during the autumn and spring terms to teach a gardening course in the Women's Training School.

During the winters we have tried to evaluate the different experiments on which we are working and have been encouraged by the progress from year to year. Whenever I am awake I am usually planning some experiment with my trees. Alice insists that I move them around so much that someday I can just snap my finger and they will jump into a new place! We have tried to keep up with our reading in the lines of our work, but if we are now nearly caught up with what we have, I fear it is largely because we have had to discontinue a number of the scientific periodicals. Alice has studied botany and horticulture and our discussions have been a great help to me. She has put our library into usable condition and done some microscopic study in lines that interested her, in addition to keeping up with all of our experiments so that she can help me plan the next ones.

This past year she has devoted her spare time to music. She had always told me that she could not play the piano, but last winter while she was in Shanghai with her sister, who was in the hospital, she used her time reviewing the music lessons she had taken as a child, and surprised me. Of course we got a piano and, with her perseverance in practise and lessons during the summer, the music has been a great pleasure to us.

Before we were married Alice rather timidly told me that she couldn't cook, but I told her I could, if necessary. The sign in a Colorado restaurant, "Don't divorce your wife if she can't cook; keep her for a pet, and eat here", hardly benefits us for whatever food we are to eat must be prepared, and cooked here. Because of the winter isolation and the difficulty of getting any but the most ordinary

foods, Chinese servants do not like to work here at the Beach the year round, though they are glad to come during the summer. If they are accustomed to city life they find it even more difficult here than we do, for we like the simple life.

Alice claims that her ability to cook now consists in simply following a cookbook, but I tell her that is more than I can do and I wish more people would do it if thereby they could turn out food like hers. Not only has she learned how to cook, but she has trained five servants to do simple cooking within that many years, and then they have yielded to better social and financial opportunities elsewhere. We don't blame them too severely, but our servants almost have to hold to the same financial standard and principles we must apply in the agricultural station. We have had several boys in the experiment station who might have made good cooks, but they had been taken in and trained for special agricultural work, and we haven't felt free to turn them into cooks. Now for the first time we have a worthy boy who has no special responsibility elsewhere and Alice is beginning to train him to help her prepare our meals. We hope and pray it succeeds this time. We haven't been able to decide whether to name Alice and her kitchen the "Institute of Culinary Arts" or the "College of Servants' Studies", but Alice prefers the latter, with apologies!

Those of you who know Barbara and the joy she has brought into our home will wonder that we have kept her out of the story thus far. Each winter as we have tried to write this letter we have made notes about Barbara, but she changes and develops even more rapidly than our experiments, and is now a young lady of three and a half years. She came to us while we were in America, and at the age of a month made an automobile trip half-way across the continent. Alice insists that I took her through the petrified forest to influence her toward my profession! Before she was six months old she crossed the Pacific, but all the traveling seems to have agreed with her for she has never had a real illness.

When she was a year and a half we wrote you about her dimpled, rosy cheeks, brown eyes and golden curls (you never received the letter for this is it, and now her hair no longer curls). Then as now she insisted on going outdoors every day, no matter how cold the weather. At that age she put her outdoor-clothes on the shelf when she came indoors, but putting things away has become less interesting now than it used to be. We have tried a plan of confiscating (she loves the word) toys when they occupy the floor for

too long a time but she can play the game too;—the other day she loaded me down with her dolls and her new book with pictures to be colored, and even gave me the crayons which had been properly put away!

She has always loved new clothes and been sure that all packages that come, are for her, which is almost true, for her grandmothers and aunts seem to enjoy sending things as much as she enjoys receiving them. Christmas has been a rich experience for all of us the past three years. The day begins before dawn with the thrills of the Christmas tree.

Last winter when Alice was suddenly called to Shanghai, Barbara, who then said she was "half-past-two", announced that there wouldn't be anyone to take care of Daddy if she didn't stay and we had a fine month together both working here at our desks. Later I took her to meet Alice, and I made some country trips. Ever since she could say the words she has been "Mummy's Sweetheart and Daddy's Pal". First she rode around on my shoulder, bobbing about like a hunter on an elephant, and later on a little one wheel cart, as I went around the experiments.

Barbara loves flowers. She enjoyed her garden last year and is now planning one for next year. She wants to learn to paint pictures like some she greatly admires, but insists on her ability to teach Alice the proper touch to be used in playing the piano. It was a great disillusionment when I told her I really could not play the violin, but she came back immediately with an offer to teach me.

Now she is learning to tell time and knows when the clock indicates her bedtime, but the other night when we asked what time it was she quickly grabbed the cat and hurried to her box, insisting it was the cat's bedtime and not hers. The flowers, cats, canary, fish, rabbits and police-dogs help her pass her day. A good sense of humor keeps her joking and makes her lack of playmates during the winter much easier than it would be otherwise. She doesn't cry if she gets hurt through her own fault so we hope she will have a good sense of sportsmanship.

Just now she is beginning the story-stage and brings book after book to be read until she knows the stories by heart, and also digs out all the experiences Alice and I can remember of earlier years. Then we hear her retelling the stories to herself, or the dolls, or the cats,—sometimes very accurately and again with charming variations.

She makes up her own songs, both tunes and words, and her favorite at present is always the same. For a year she has enjoyed sewing and one of the best pictures we have of her was last winter when she was darning a pair of socks. It thrills her now that she can dress and undress herself.

Although she has a desk here in my study, a sandbox in the greenhouse, a tumble-room, and both the love-nest and the living room floor are usually covered with her toys, she sometimes prefers the place we fixed for her,—a balcony next to the greenhouse with a desk of many compartments and proper lighting. Her school days will not start for several years but she likes to think that she has to study.

Many times during the day and night we feel that surge of gratitude for her lovable disposition and what she means to us; what greater inspiration is there in life than a little child praying for all the loved ones, or clinging to one when sound asleep!

We know now why parents are seldom as sure as some others about the rules for training children and we think the best one we have heard is just to do the best you can under the circumstances; remembering that society may make the child pay in later life for the parents' failure,—through laziness or inconsistency,—to lead the way into the best adjustment toward life.

There are many things for which we are thankful;—our home and health, plenty of work and strength to do part of it, and the encouragement from our experiments that they may bring help to others.

The greatest help that has come the past year has been the return of our Paul Chu Lin Kao,—Barbara fondly calls him "Uncle Paul", after his four and a half years of study in Nanking. His Christian radiance, and ability in the lines of our work have made us thankful for him and his willingness to return to our work instead of taking more financially attractive offers. Our station at Tung-hsien, near Peking, is now in his charge. His special responsibility in our work is the control of insects and disease on fruit and extension work through the churches and institutes. I am looking forward to a few days with him soon, to consider our work and problems prayerfully and see what our focus for the new year shall be.

Furlough Findings

It is rather late to be writing about the experiences of our furlough for within a year we will be nearer the next furlough than the last one, and waiting till this date to write to all the people who were so good to us is a bit like saying "Thank You" now for the cookies I ate as a boy. Not until now have we found time to go over our notes and prepare this account of the study trip around the world, and since we shall probably never again travel so far in our studies, we want to retain and use these experiences and probably the best way is by sharing them with our friends.

At the present stage of our task here, nothing could be more valuable than an understanding of the related work that is being done elsewhere in the world. With the travel and contacts which it was our privilege to have we now know not only where to turn for help but also how to interpret the information we may receive.

One of the first commissions of these pages is to carry greetings to the friends in several countries who helped us so wonderfully during our furlough. We will never forget the hospitality that was offered us in greater measure than the limits of time permitted us to accept. This came not only from people with whom we had some previous acquaintance, but also, again and again, from scientists whose response was called forth by that willingness to serve humanity which generally marks the scientific man. We are fully aware that the time and materials so freely given us were given at a cost greater than ordinary, for most of the institutions were trying to carry on with cuts of budget and personell.

We found everywhere a fine interest in China. When we tried to thank one of our American research men for all he had done, he replied that America should be willing to help China, for many of our choice plants have come directly or indirectly from the Flowery Kingdom. Again and again we were told just to write if any further assistance was needed, and that promise has been fulfilled a number of times in the past three years. Only those who have been located alone out on the frontiers can realize the meaning of this bond of association with the able men of his profession.

When we visited the experiment stations of Europe and America with all kinds of electrical apparatus for controlling and measuring environmental factors I realized how nearly I had forgotten the modern mechanical world in my attempt to fit into these simple agricultural methods. At first it seemed there could be no bridge

between the two environments, but as I thought further it became clear that this land of small, hand-worked farms is the ultimate testing ground for the discoveries of science, for half the world still lives this simple rural life and must so continue for an indefinite time. It is a fascinating game to try to fit the current discoveries of science down upon the life-pattern of these millions of people. I found many of our strongest men already playing this game, and enjoying the task of matching their keen intellects against the problems that arise in attempting to apply the most intricate rules of science to the remote situations in human existence. Meeting such men made us feel that we had the resources of all experimental endeavor behind us.

We would not give the impression that we are the only ones faced with these problems in China;—there are hundreds of us, both foreigners and Chinese with training and ability, scattered over this vast area, and we speak for all of them when we say that the needs are so urgent and so many that one of our greatest problems is to hold steady at work on a few of them until we secure reliable results. Before we left China, we studied the work being done in Nanking and Canton, and while much of it is not adapted to our climatic conditions (China is such a tremendous country), the amount and quality of research being done there is most encouraging. The progress this country has made in the past decade is phenomenal when one considers the obstacles encountered.

Alice always enjoys getting back to her Nanking home, and sometime I hope to go with her to all the interesting places of which she has told me. Friends in Peking had started us on our homeward way with a warm farewell, though the thermometer was below zero, and the thoughtfulness of friends along the way made a fine beginning for the trip. Our friends in Canton soon made us feel at home on the Lingnaam campus and gave us many interesting experiences and contacts.

The Tropical Forest

On our homeward trip we thought we knew quite well what we were seeking and where to find it. We stopped a week in the Philippines for a rest, expecting to find nothing in the tropics directly applicable to our situation, but to our surprise found our greatest help in one of our major projects. There we found a well established program of land reclamation by the use of leguminous trees, following much the same lines as our experiments, but on a larger scale and

further advanced. If only our project can work out as successfully it will be something for which to be thankful. The forest experiment station there began using ipil several years ago on abandoned eroding hillsides with the idea of interplanting rare tropical trees later, but found the ipil a more valuable tree crop and one that can quickly reclaim lands that are on the way to destruction.

For anyone interested in forestry it was, of course, the experience of a lifetime to wander through the tropical forests as I had always dreamed of doing. During the several days we wandered through the dense, luxuriant tangle, taking care not to get so lost we could not find ourselves. On the mountain trip some friends and two foresters accompanied us and made it a day we shall never forget. The way one of the foresters swung up the vines that festoon the tropical forest, to the tree-canopy a hundred feet above us, and with skillful strokes of the bolo knife cut a large tree branch on which grew a beautiful white orchid, and brought it safely down to us, is a story in itself. Another story might be written about the discovery of a large bird's-egg near a pool of boiling mud where the mother hen had buried it to let the heat from the mud hatch it and save her the trouble. We found one of the newly hatched birds, and then watched the forester hold the bolo knife with his toes to shave splints from rattan and weave a pretty basket in which the bird was carried all day long. We encountered no danger more fearful than the leeches which infest the higher zones of the mountain, but since we had been carefully advised how to protect from them, we gave them none of our blood.

The trip up this mountain shows such changes of flora with altitude that it has become famous among botanists. The dwarfed mossy-forest near the top is such a contrast to the tangled grandeur of the lower zones that one finds it hard to believe the distance between them is so short. The amount of scrambling, sliding and stretching over slimy trails also makes it difficult to be conservative about the distance. The damage to ones clothing gives some indication that one may have traveled the road to the poorhouse;—the only reason that two of our party didn't come home in a barrel was that there were no barrels, and we had to use our large straw hats to cover places where clothing was most damaged.

The friendly way in which the people at the agricultural station took us into their circle certainly tempted us to accept the invitation to build a little cabin in the edge of the tropical forest and go there for our vacations. Nothing could be more nearly ideal, but our vaca-

tions will simply be a period of rest at home, if we can get it sometime during the year.

We greatly enjoyed the voyage on through the southern waters. We used much of the month trying to organize our agricultural experiences of the past and to prepare for what we should see in the countries in which we were to study. Alice loves to tell how I turned over in my berth one night as the ship ploughed through a tropical downpour, and murmured sleepily,—“Oh, won’t this rain be good for the kaoliang (the main graincrop in North China)!” There is seldom a waking hour in which I do not think of agriculture and it seems also to have found me in the dark, on a tropical sea. She also claims that I was talking in my sleep here the other night about how hard it is to make trees grow in this poor soil, and when she told me I did not have to work in my sleep, I replied “Thank you, I won’t then”. This proves that I am both obedient and polite to my wife, when I’m asleep.

We made good use of the time the boat was in ports and acquired a slight understanding of the work in rubber groves and cocoanut plantations. Our experiences were quite limited however, and we would not in any sense pose as world travelers who have seen everything. We did see most of the known wild animals but our hunting experiences were all confined to hunting zoos, which we did at every opportunity. Not only is it the safest place to hunt but one can be quite sure of finding animals! The tropical botanical gardens with their brilliant flowers, magnificent trees, and the monkeys playing everywhere will always be remembered among our most interesting experiences.

The Holy Land

Our week in the Holy Land was one of the best of our year. We went there especially to see and understand the country where Jesus lived and interpreted life with illustrations drawn from the fields and the flocks that pasture among the hills, the grain from seeding time to harvest, and the good fruit that can be produced only by good trees. The parables have a marvelous new meaning after one has met a shepherd leading his sheep across the Brook Kedron, watched the fishing boats at sunset on the Sea of Galilee, and sat on a hillside as we did one day to eat our lunch among the flowers of the field which grew in such abundance that there were a dozen kinds within arms reach. We were fortunate to be there when the land was carpeted with color and also in dining and traveling with

the best botanist in Palestine. From the scarlet of the anemone, tulip, ranunculus and poppy that grow on the hills, to the dainty cyclamen in the crevices of the rocks in the Garden Tomb we saw a range of beauty and color that helps us to realize what Jesus meant by the Flowers of the Field.

There is a great similarity between the countryside of China and that of Palestine, and the marketplaces of the two countries have much in common, so our brief acquaintance with the Holy Land should be a help in presenting Christianity here. We went to Palestine to find these spiritual values, but also found several helpful ideas for our work, for their problems of deforestation, erosion, and fruitgrowing are in many respects like ours. The research forester in Jerusalem who showed us the work that is being done, had done the fieldwork for his doctors degree in the Yale forest the year after I finished mine, so we had much in common besides our work. It was good to recall our Yale acquaintances and experiences.

Study in Europe

Any mention of the studies in Europe which we felt were most helpful should include the fruit-gardens, the state and communal forests and several outstanding examples of profitable use of land that otherwise would have been wasteland.

Fruit Culture

Most of the orchards which we saw might better be called fruit-gardens for commercial planting on a large scale is just beginning. The practises of the large commercial orchards in America are in general less applicable to the situation here in China than those used in the smaller European plantings for the relation of land to population is more similar in China and Europe, where the emphasis is placed on farms and orchards of a size that can be cared for by the labors of a family. It was this similarity that made us sure that we must seek help for our problems in Europe as well as in America.

In many respects, Europe is far behind America in fruit culture, and also in the management of the crop from the standpoint of its use for food. Imported fruit dominated the markets during the spring we were there. Refrigeration of fruit to keep it for the late winter and spring market has not been as generally used in Europe as in America, but several of the experiment stations proudly showed us their new storage cellars with complete electrical control. With an increased planting of good table varieties of fruit it will be difficult

for America to hold the European market. Fruit can be grown in Europe with as little or less difficulty, and is commonly planted along the roads and paths. Most of this roadside fruit is used in fermented beverages, for in general, Europe has emphasized drink at the expense of food. Several indications of an awakening to the possibilities of better uses of fruit were noticable in the experiment stations and in a conference held in Paris to further the development and use of fruit products other than fermented beverages. This is an interesting development in view of the premium that Europe has always placed on her wines. No one can deny that sparkling wines add something to a dinner table or sideboard, but if as much care in blending flavors and color qualities were given to the preparation of unfermented fruit drinks as are bestowed on the famous wines, all of the beauty and the best of the table values of the wines could be enjoyed in the fruit juices. Perhaps an American should take pleasure in seeing American fruit dominate the European market because Europe is too full of her wine to realize the situation, but it might be added that probably more American money goes to Europe for wines than is returned to America for fresh fruit. As the head of one of the continental experiment stations remarked, it is not alone the question of food values, but also one of relation to health. So much of the land and labor of Europe is producing wines instead of other fruit products.

In Southern France most of the land we saw was divided into little farms and orchards or vineyards, the boundaries being formed by tall narrow poplar or cypress windbreaks. We studied these orchards during blossom time and later saw the German orchards in full bloom as we went up one side of the Rhine and down the other. Some of their cultivation, grafting and pruning methods are well worth trying here. In many places the fruit trees are trained against sunny walls. This utilizes the heat and protection of the wall in climates where sunshine is deficient, but would be less important in our sunny climate. One of the most important problems in our work, however, is to find the best methods for growing a few fruit trees in the Chinese courtyard.

Forests

Alice became so travel-worn in our forest study that she insists we went to every forest in Europe, but unfortunately we missed several! We did see good examples of the different types and the results of different forest policies.

On Good-Friday we were in two German forests, one belonging to the state and the other to the city which it adjoins. Since it was a holiday, the entire city, it appeared, moved out into the forest. Everywhere were crowds, sauntering along the paths or resting under the trees, but we did not see a single instance of the trees being damaged by careless people. In addition to their social and aesthetic values, these forests when well-managed yield a considerable income to the city or town which has planted them.

We could not avoid the thought that adjacent to many of our American cities are tracts of idle land which could bring these benefits to thousands of people. The difficulty in accomplishing this lies not so often in getting a forest well planted as in protecting it from careless lack of loyalty to community interests. This is doubly true in China. We saw such splendid regard for parks and forests in several countries, however, that we cannot believe it is an impossible trait to develop in America and China.

The most beautiful forests we saw, excepting those in the tropics, were in Switzerland and in both the tropical and the Swiss forests their peculiar charm was their naturalness. In some parts of Europe forests were formerly planted and harvested like corn-fields. Only one kind of tree was grown and when it reached timber size the forest was cut clean, the peasants being permitted to dig up the stumps and take out all the vegetable matter for fuel, a practice similar to that which prevails here in China. After a few crops, covering one or two centuries, it was found that the land would no longer grow the trees. The nutrients which that variety demanded had been exhausted from the soil, for everything was taken away and nothing returned. Even more disastrous with the removal of all the trees, a complete breakdown of the forest environment takes place. The shade is gone and the humus burns out, killing the micro-organisms that thrive in forest mould and condition the soil. Snow melts quickly and the rain beats down on the unprotected earth, and the rich black soil of the forest, which is needed to grow a new forest, is carried away in floods.

As a result of these experiences the forest policy has shifted to one of cutting only part of the trees at a time, and in many places the use of two or more congenial varieties together, as natural forests grow. It is possible to use as a secondary tree one with the ability to take in nitrogen from the air and thus build up rather than deplete the soil.

Since this is the principle on which we are working here, we inquired about it from place to place, but found work in that line has barely begun. We found one striking example in which a nitrogen-gathering tree was planted under an old pine forest that had ceased to grow with the result that the old pines again began to increase in size. In several countries we asked forest experts for lists of trees and shrubs which might fit into this situation in China, and received some helpful replies, though few of them are working with land as sterile as ours. Word from any who have had success in these lines would certainly be appreciated.

When we asked our question at the Ministry of Forestry in France we were advised to use one of the two pines which are generally planted on the poor soils of Europe, both of which we have tried. On hearing that our soil thus far has refused to nourish either of these pines, the French expert threw up his hands in the dramatic manner of his country, and replied that there is no way to grow trees on such land. We feel there is hope, however, in first establishing a leguminous tree or shrub, several of which show promise of bringing our worst soils into condition for other trees.

Switzerland is proud that it has always emphasized the natural or mixed forests and never permitted her forest lands to deteriorate. Of course there have been different trends down through the centuries; such as the predominance of spruce until other building materials decreased the need for spruce, and then more beech until the uses for beech were met from other sources. One of the principal functions of forests in Switzerland is to prevent erosion of the mountain slopes and valleys, for there is very little level land in the country. So rigidly is the land controlled by the government that no owner can cut his trees without permission of the forestry department and a promise to follow their recommendations in replanting the area cut. This may seem dictatorial but it is necessary to prevent erosion and so effective is it that in traveling all over Switzerland we saw only one badly eroded slope and that was due to a land-slide.

Even in the tropical possessions of Holland, where trees are the weeds of the jungle, we found a strict government regulation of every tree that is cut, and provisions for replanting.

Care of the Land

For the thrifty use of land that would without development and supervision be wasteland, it appeared to us that Switzerland and

Holland are outstanding. Switzerland has made her steep mountain-sides grow forests and meadows. Her dairy products from the meadows find markets throughout the world, but hard work is required to maintain the luxuriant growth of grass. Every spring the meadows and pastures, (and even the lawns of the most fashionable resorts) are buried deep with the manure accumulated at the stables during the winter. The farm women in many cases work side by side with the men in spreading the manure over the grass-lands, for upon this process of giving back to the land part of what it has given, depends the abundance of grass and therefore the financial income for the year. When we saw this we thought of China and her bargaining with the land, for the amount of food she can hope to raise in a season is limited by the amount of fertilizer that can be prepared, — there never is enough.

The beauty of the forests and meadows, as well as their material products, are of great value to Switzerland; — perhaps the beauty of the country is her greatest asset, for tourists come from everywhere to enjoy the beauty and peace and health that fill her valleys and make her mountains a blessing to the world. In the fertile meadows are myriads of flowers changing from season to season. One day we gathered a bouquet of snowdrops that were pushing their white bells through the borders of the deep snow that buried the mountaintops. On warmer slopes the meadows were colored by purple and gold crocus. Another day we rested among gentians so blue that no words can describe them. We came out of a forest one day to find before us a meadow where poets narcissus concealed the grass by their abundance.

In many countries the hillsides have been left for the mercies of climate to determine whether or not erosion should steal the soil and expose the bare rocks beneath; even worse, man has often worked against nature in places where otherwise the climate would have helped to produce a fertile land, but the people of Switzerland have cooperated with their climate and made of their country a veritable paradise. Not only by their forests and their meadows have they worked to prevent erosion, — we watched them work during a down-pour of rain to guard the soil of their gardens and vineyards lest any of it be lost. The family hotel to which we returned as often as possible while we were in Switzerland was built into a hillside so steep it would not have been possible to walk straight up the slope. Yet by building retaining walls to hold the narrow terraces enough fruit trees had been planted to produce the fruit served in the hotel,

and this was an important financial help to them, for preserves or jam with the hard, crisp bread and butter, and either coffee or chocolate comprise the European breakfast.

One of the several industries that help to make the long winters profitable for the Swiss mountain farmers is the wood carving which supplies the tourist trade and gives an income from both labor and wood that is not at all small. Only in Switzerland did we find carving of wood and ivory as beautiful as that done in China. Our only fear is that the rare skill in carving which the Chinese have possessed for centuries will be lost if it is not encouraged, for it is an art which must be passed on from generation to generation if it is to survive the impact of cheap machine-made imitations.

Holland has defied the sea with dykes and used great tracts of land that would otherwise be submerged. The canals serve for drainage, waterways and divisions between fields or meadows. Great areas of sand-dunes, formerly only wasteland, have been leveled and transformed into the world-famous Dutch Bulb Fields. We had the good fortune to be there during blooming time and saw those miles of color, — a mammoth quilt of hyacinths, narcissus and tulips set together with canal-bordered pastures and their picturesque windmills.

Among other examples of the use of wasteland mention should certainly be made of the tiny gardens we saw in several countries, often along railroads and near factories, — the kind of places that are used for dump heaps in cities which have not entered into the transformation of such places. The spectacular growth of this type of land reclamation is one of the encouraging trends in our modern world. It was first developed in Germany by a man who saw its value in food production during the difficult post-war years. The idea spread rapidly into other countries but in Germany we found the furthest development and use of these gardens. It has become a retreat from city life into nature, and many of the plots, only a few square rods in area, have a tiny cabin, neat, but evidently built by the owner out of available materials, in which the family can prepare meals and even sleep. In the soil were growing spring vegetables but also flowers and dwarf fruit trees and bushes. During the Easter holidays these gardens were thronged with families, — working, resting and generally enjoying their bit of outdoors. The main difference between these gardens and the thousands of depression gardens established by many of our American cities is largely a matter of development. The latter, thus far, have only been food-

producing plots. In Germany especially, the idea is to provide for the poor of the cities all of the healthful benefits that can be produced by tilling a bit of land, — food, recreation, health, neighborliness, an understanding of nature and the possession of something beautiful.

One friend remarked that descriptions of trips through Europe to study art, literature, or politics are common, but reports on Europe from a forestry or horticultural viewpoint are something new. We only hope that we have made this account scientific enough to interest our professional friends and yet not so technical as to bore those whose training has been in other fields. After all we are all united in our interest in meeting human needs.

An Understanding of Europe

Many of our friends will ask if in this opportunity of a lifetime we missed the values which usually take people to Europe. We knew when we planned the trip that we must guard both our energy and our money and tried to select the places most important to our object in view. Alice had once made the trip through Europe and her previous experience enabled us to do without guides, for the most part, which made the trip much more pleasant.

Although our first consideration was necessarily for our work we saw so many interesting things and people without going out of our way, that the trip will always remain one of the great experiences of our life, and European events are now noted with an understanding previously impossible. A Sunday in the Louvre, a few hours in the art museums of Marsailles, Lausanne and the Hague; the cathedrals in Marsailles, Paris and Cologne, — these are worth weeks of quiet study. One of the thoughts that came as we viewed the treasure-rooms of the cathedrals was that people of that faith gave their best to God, — jewels beyond value. Yet there is a best that each of us can and should give, — our best efforts to live beautifully.

On Easter Sunday we first heard the famous organ at Haarlem and then rode through the rainbow of bulbfields to the Hague where we visited the prison referred to in the torture scenes of "The Black Tulip," and then appropriately for Easter day, went to the Peace Palace with its reproduction of the Christ of the Andes and other tokens of peace.

We had the good fortune to go to Versailles on the first day of the spring when the fountains played throughout the vast palace

grounds. From Marsailles we had gone out to the Chateau d'If and shuddered at the scenes of the "Count of Monte Cristo". One rainy afternoon we went to the Castle of Chillon and were led from one to another of its historic rooms and into the dismal tower and dungeons against which the angry waves of the lake have stormed for centuries.

On a walk through the mountains of Switzerland we came into the Gruyere Valley, famous for its cheese, but once the scene of feudal combats, relics of which are well preserved in the Gruyere castle. The frieze on the wall which showed the women armed with spears, driving their torch-bearing goats before them as they routed the enemy that had attacked while the men of the castle were away on the Crusades, is only one of the relics these castles preserve which lend color to mediaeval history. One could spend days studying the construction of walls and furniture, some of which date back many centuries, and the tools and implements of different periods which have been preserved. The most beautiful memories of that day were the field of gentians in which we rested in the morning and the great spruce forest on whose mossy floor we rested in the afternoon, just long enough to miss a train, but by changing trains three times we finally reached home by a round-about-way.

Most of our travel in Switzerland was done by train, made possible by the special tourist tickets good for eight, fifteen or thirty days. At the rate of exchange when we were there this enabled us to travel all day, (and all night if we cared to) for less than two dollars a day. Since these tickets were usable on all government trains and boats, it was a most convenient means for us to carry on our study, for we could get off a train in any place where the orchards or forests looked inviting, and either walk to another station or return for a later train. In this way we covered most of the country, going over some of it, — including the wonderful Bernese Oberland, several times enroute to other places. The slat seats of the third-class coaches became tiresome and we got air-cushions, but the views from the large windows were so marvelous that one could overlook a little fatigue. On day we went up near the German border to see a state forest which one of the Chief Foresters, a fine Christian man, had urged us to see. When we reached the place, heavy snow was falling, so we changed our minds and by a series of transfers circled around through some country we had not seen. The next day it was snowing again so we went down to the Italian border. As we emerged from the long tunnel that takes one through the moun-

tains between German and Italian Switzerland, we came into brilliant sunshine. Later we spent a wonderful day in the state-forest, after the snow had melted.

The pension where we lived most of the time was over in the French part of the country and we had a chance to observe the differences in the three distinct parts of Switzerland, but the fact that these people with different national heritage have held their country together during wars that involved the nations to which they are related is one ray of hope that peace will triumph in the world, and the lead that this geographically divided country has taken in world peace is another bit of light in the darkness.

We came to feel almost at home at the pension, Hotel Montbrilliant, near Montreux, to which we returned whenever possible, for the people in charge were good to us, and it fulfilled our requirements, both financial and otherwise. It is located up among the vineyards and orchards yet within a few minutes walk of wooded hills and two railway lines, and centering here made it easy to get to the borders of the adjacent countries, all on our railway tourist tickets. The view from our room was out over the lake and across to the mountains in France, and our table in the dining room had a lovely sunset view over the hills. The food was plain but good and did not require as much supplementing as we found necessary in some places. We always carried a lunch when we went for a day's trip and during the month when our finances were uncertain due to departure of the United States from the gold standard and further cuts in missionary salary we bought just as little as possible outside the necessary. We often laugh about our experience in Eastern Switzerland when one day we sat down in an orchard to eat a lunch that consisted only of a loaf of bread, a little cheese and two onions and the onions were so strong we could not eat much of them. A beautiful herd of Brown-Swiss cows came over to call on us and Alice scrambled, but I stayed to make friends with the cows. They ate the remains of our onions though, and we have often wondered what the effect was on the farmers milk!

Although we traveled and lived as inexpensively as we could, during all our time in Europe we did not experience any discourtesy and in many cases people went out of their way to help us and make things pleasant for us when it could have been of no advantage to them. Our faith in the innate friendliness of the common people has certainly grown with our contacts and experiences in the Orient, Europe and America.

Adventure

We are sometimes asked about language difficulties; in most places some English was understood. We revived what French we had known and acquired some more as we traveled and managed to get along and even gather the information we sought without any serious difficulties.

Our one wild all-night adventure was due to our own carelessness in not inquiring more carefully about details. While still in Marsailles we decided one afternoon to take one more trip out through the orchard country. Barely out of the city the beautiful new bus broke a fan belt and after an hour's delay getting a new one the driver determined to make up time. He was fat, red-faced and hot-tempered as had been shown by his remarks to the bus and the passengers, who were irate at such a delay. The road was the main artery out of the city, crowded with heavy trucks, and our bus, when again on the way, swung in and out among traffic like an elephant on a hot stove. I'm not sure whether it was dodging a perambulator that crossed the road or a big truck of sulphur that came the nearest wrecking us before we reached the open country. Wouldn't it have been sad to have been killed by a perambulator?

As we passed between two groves of scattered olive trees a flock of sheep in one decided that the grass, (of which there wasn't much), on the other side of the road was better than where they were, so with no attention to traffic laws or our approaching bus they filed across the road. The shepherd shouted and the ugly black dog acted. He grabbed the hind leg of the last laggard sheep and tried to pull him back across the road but the momentum, or the stubbornness, of the sheep fortunately dragged the dog to safety. Above the wild siren of the bus we heard the screaming of the brakes and with a treacherous swing the bus passed on without making the mutton-chops or hot-dog that seemed inevitable.

Some distance ahead the road passed into a tunnel of the polared sycamores that one sees in Southern France, and here as everywhere they were pruning the branches so that along the roads were great piles of fuelwood. In dodging between these a branch caught in the spokes of the wheel but again we escaped disaster.

At one of the village stops, — not the one where the driver stopped to flirt with some woman, some soldiers boarded the bus and paid no fare. The driver cursed them, but I felt rather grateful for they stood in front of us and I figured that if we did crash they

would go through the windshield ahead of us. Strangely, Alice did not seem to be afraid until the thing happened that brought the driver to his senses, and I was thankful for her serenity. One of the grand things about her is her steadiness in the precarious experiences that have come our way. I submerged my own apprehensions by taking pencil and paper and scribbling down the notes from which this account was recorded. Had we escaped so many deaths in China to die in France! I took refuge in counting the hedgerows, the sycamores, the bags on a truck that persisted in hogging the road ahead of us.

We slid down a hill at a wild speed, swung dizzily around a curve and started up the opposite slope, down which, at peace with the world, came a farmer in his faded garments, walking beside his percheron stallion that drew a great two-wheeled cart. Over the brow of the hill came a grey racing car at even greater speed than ours and — who knows why — the bus driver turned to the wrong direction, taking the same side as the cart he was meeting, to let the racing car have open road. But the racer followed the law, swung past the carter so close that he thought his clothes were being torn from him, swerved in front of the stallion, missed us and turned into the rough ground on the side he should have passed us and went roaring up the hill behind us. This sobered the bus-driver, and he drove carefully on the right side of the road thereafter.

We arrived in Avignon a few minutes late, just after the last returning bus for the day had left, but we found there was a train back soon after eight. We wandered up the hill to the Papal Palace and on to the park above the Rhone and saw one of the most beautiful sunsets in the world, — across the green waters of the river with the ancient bridge in silhouette.

In wandering around the park we surprised a couple of lovers in the grotto and as we retreated we discovered two spies. Kissing is the national game of France, played everywhere, it would seem.

At the proper time we reached the railway station, and boarded a coach which bore the word *Marsailles* (as well as some others, we realized afterwards) and at the exact time our time-table scheduled it, the train began to move. At the time it should have been entering the city of our destination, it was pulling into a station, and as we left the compartment we asked a fellow passenger—just to be sure—if this were *Marsailles*, only to find that we had taken the train going in the wrong direction and were a few hours nearer Paris and further from *Marsailles* than we had intended.

We finally located the station-master, and with our limited vocabulary told him our predicament. He kindly initialed our tickets and informed us that we could get a train at one o'clock in the morning, — two hours wait in a dismal rain and no waiting-room. He suggested "cinema" and pointed up a dark street. By following his directions we were soon viewing one of the wildest movies I have ever seen. The theatre closed at midnight and we took refuge in the restaurant near the station and drank chicory coffee till traintime. Our return was uneventful and we tumbled into bed for a day's slumber just at dawn, which according to some authorities is quite the smart thing to do. This was our wildest adventure of the year and it was quite sufficient.

Although we tried to conserve our energy, we took time out twice to rest and that seemed to make us only the wearier. All the fatigue from travels in China harder than any of furlough year seemed to hang over us and cut into our vitality. That is the one regret with which we remember Europe, and in fact our whole furlough, that we were too tired to really enjoy life. Never again will it be as important for us to study the work in as many places, and plans are already made to live quietly and normally next furlough within reach of three experiment stations where special help has been offered us. We do appreciate the privilege that we had in seeing interesting lands and people and are glad to share the experiences that came to us as we tried to follow our task. We realize that thousands of people would like to see the countries we were privileged to visit, and many would be willing to travel on the same frugal standard we followed that we might learn the most for our expenditure.

The feeling that we must use our opportunity of a lifetime undoubtedly urged us on, and the doors that opened in so many places we had not expected added obligations. The report that Europeans are unresponsive to Americans did not appear to be true in our case. It kept us busy being passed on to "another scientist we should see". The foreign offices of the United States Department of Agriculture were especially helpful to us. Before we sailed the men in the Shanghai office had given us letters of introduction to the offices in Marsailles, Berlin and London and these opened other contacts.

England

Our time in England was too short to use half the opportunities, and this was especially to be regretted for here there were no language difficulties and we felt more at home. I left the sightseeing

for Alice to do except for the few places she felt she must take me. Two of the nights we were in London we attended plays which English friends recommended to us and these remain in our memory as a measure of drama and of the English theater.

Several of the openings that had been made for me at experiment stations had to be declined as the time for our sailing drew near, but we did get some valuable help from the ones we were able to visit. I had long counted on the trip to Oxford, especially the forestry college where I had at one time lived (in my imagination) during the month my name was being considered as a candidate for a Rhodes Scholarship, and it was a disappointment when we found that our visit happened to be during a vacation time and most of the buildings were closed. We did get into two of the colleges and absorbed a bit of the fine old tradition that haunts their halls.

Rothamstead, the oldest experiment station in the world, famous for its plots where for a century the same crops have been planted year after year, both with and without the addition of the various kinds of fertilizer, also gave us some help on one of our problems,—the need of humus in the soil.

We made five trips to the Royal Botanic Gardens at Kew to study their collections of trees and shrubs and work in the library and museum. The beauty of the Gardens is beyond description at the season we were there. The azaleas and rhododendrons were a burst of flame and crimson, and the woods about the Queen's Cottage a sea of bluebells.

Our two trips down to the fruit experiment station in Kent, where we were offered more hospitality and information than we can record here, were combined with delightful visits on a lovely estate, the home of a sister of two of our best friends in China. In their fruit gardens we found splendid examples of the methods of culture we had been studying,—cherries, peaches and pears trained as vines against the walls. The drives on which they took us through that part of the country enabled us to see much more of Rural England than would otherwise have been possible. We were heartsick for the country after just the few days in Paris and London and the long walking trip we had planned for England had narrowed down to a single day of rambling along brooks and lanes and through the woodlands that could be reached from London. On the last day before we sailed for home, our hostess drove with us over historic

old roads and carefully selected several places which she knew would interest us, ending the day and our visit in England with a picnic at the ruins of an old castle that has been made a national monument.

America

We crossed the Atlantic, tourist class, on one of the fastest boats, for we were impatient to get home. Had it taken more than four and a half days to make the crossing we would have felt that the vibration of the ship's motors which was so wearisome in our cabin was sufficient reason for changing to a better cabin. We landed in New York on one of the hottest days of the summer and managed to be there again for others that were just as bad. Fortunately our headquarters for the summer were out on the farm that had been second-home to me during the years at Yale. Here was a large orchard to study and all the practices of a modern farm. It is a beautiful place, with about a hundred acres of woodland and an equal area of ponds and streams interlacing the woods, with canoeing and swimming. It is a perfect place for a vacation, and we allowed ourselves a week to rest and were only the wearier. From here we made our study trips out to different selected points but it was always a joy to get back to this farm, not only because it was such a beautiful spot in which to keep up our desk-work, but also because it was the home of genuine friends.

It was possible to spend only one night at the Yale Forest, but that gave me time to retrace the paths over which I carried soil-samples during those summers I studied in the forest, and to show Alice the thousands of pines planted each year which have made a splendid growth since I last saw them. We visited the grave of the man who established the forest,—the man under whom I had done my study, and never have I felt that a grave was more appropriately or beautifully marked. The stone is a great rough boulder in the center of a natural circle of towering pines. We became slightly acquainted with the group who were then doing research in the forest and wished we might have stayed longer.

We had only a few hours on the campuses of the schools which hold so many memories for us, — Oberlin, Nebraska Wesleyan and Yale, and saw only a few of the friends we had hoped to see. It was fine to see those few for by another furlough most of the old friends will be still further scattered, and it may not be possible for us to go East at all.

Most of our summer work was done at Washington, D. C. and at the New York State Experiment Stations. The day at Geneva tasting all the varieties of cherries, berries and other fruits that were ripe is a never-to-be-forgotten memory and remains a vision of the time when we shall have fruits of like quality and variety in China.

If we found the help offered in Europe more than we could accept for lack of time, it was doubly true at home, and these contacts with earnest men in our profession continue to encourage us. The maintainance of these contacts depends largely on whether we can do our part in the cooperation which is offered. There are certain ways in which we can return some of their favors, for interesting plants from China are greatly desired by the experiment stations. Our greatest difficulty thus far has been to find time to do even the collecting of seeds we wanted to send home to them.

Short visits were made to a number of experiment stations and everywhere we found such a cordial welcome that we wished we might stay longer. In the west, our visits to the two federal stations at Cheyenne and Chico, the Institute of Forest Genetics, a month of study at Berkeley and a trip up the coast to select nursery stock to bring back to China, all gave many valuable suggestions for our work.

Our good old Hudson car gave us splendid service at a total cost of less than one railway fare for the distance traveled and made it possible to reach the places important to our study. We named it "Home, Sweet Home" for it was the only home we had until we got to the west coast where we more or less took possession of the Bowen home,—at least the garden which Alice's mother turned over to me to work my experiments and propagate plants to take back to China.

We had hoped for a month of rest before we sailed but the dentist found that earlier reports on the good condition of our teeth were a mistake and we spent the month resting in the dental chair, which brought us to the rush time of preparation for sailing and assembling our cargo. Had it not been for the help of friends and relatives we never could have prepared and gotten aboard the several tons of plants, trees and agricultural equipment that we brought back.

Alice's sister and my sister came and helped us, and both of Barbara's grandmothers went down to the boat to see her sail. It was wonderful for us to have had both our mothers with us all the winter. Alice's father was in the east most of the time speaking on China, and we missed him. It is never easy to leave family and

friends and sail away for so long a time, but we are fortunate in that our loved ones also have that interest in our work which enables us to be ready to return to it when the time comes.

Most missionary furloughs include two summers, since many of them have to be fitted into school schedules, but it is better for our work to be away just one growing season and therefore to go home at the beginning of one winter and return at the end of the next. We sailed on a freight boat loaded with lumber and steel rails in addition to my cargo. We spent nearly six weeks getting here and it was twenty-eight days from the time we sailed till we saw our first land and our first boat, off the coast of Japan. Food and accomodations were better than we had expected, but it was a tedious journey, justified only by the fact that we saved enough money by traveling thus to pay for a goodly number of the trees we brought with us, and who knows what they may become? I sometimes joke about coming steerage for I spent much of my time down in the hold with my trees,—airing, watering, or trying to check the moulds that caused heavy losses among the smaller plants. Fortunately the larger stock came through in fine condition and those are the ones that would be more difficult to replace had I lost them.

We are trying to use the help, that was so freely given by so many interested workers, to hasten the solution of the problems that we have tackled. Those who are actually working in the soil here realize the difficulties in bringing about agricultural improvement; — practically all the rain falls within three summer months, bringing floods, and the remainder of the year, except for rare showers, the land is dry. The fact that the Chinese farmer practises general farming with so low an annual precipitation, and continues to harvest a crop from the impoverished soil after thousands of years shows his ability. Any plan to improve on his methods must deal with the combined factors that handicap him, — poor soil, lack of fertilizer, need for fuel, extremes of climate and the demands of a dense population.

Since trees and shrubs are less affected by flood and drought than grain crops, and the need for them is so great, their use in great numbers appears to offer some hope. No other line of attack offers as much promise for breaking the combination of factors which now prevents agricultural improvement. We are thankful indeed for the results of our experiments and study the past few years.

We realize that experiments of this nature should be given far more time before any prediction of their value is made, but the pressure of the need for this work seems to justify this presentation, in which we have tried to be conservative.

China's Agricultural Problems are so Inter-Dependent
that they constitute a Vicious Circle which must be broken as a whole.

Our Program attacks the situation at the center.

There is a vast total area of unproductive land in China, if one counts gullies, hillsides, streamsides, roadsides and other wastelands.

Farm labor is now idle half the year and there is a great need for constructive employment during slack seasons.

This land is not merely unproductive; — it is a menace in floodseason. The hard, bare soil cannot absorb heavy rains. Torrents tear across the farmlands, stealing the topsoil and fertilizer, both already insufficient.

Millions of gullies pour their unobstructed waters into the main streams faster than they can be carried away.

Trees and shrubs, which naturally control water-courses and retard the run-off, have been destroyed for fuel.

Erosion not only cuts away the land but the silt fills the channels. The floods break through the boundaries with untold loss of life and property.

Rain that falls on hard barren slopes is lost, whereas that on wooded slopes sinks into the ground and provides moisture for lower levels in drier seasons.

Farmers in North China usually have to depend on moisture retained in the soil from the previous year to start their spring crops.

Humus is urgently needed in the farmland to prevent clods, to keep the soil porous so it can absorb and retain moisture, and to break up hard rocky soils and liberate plant nutrients.

The deficiency of nitrogen in the soil makes urgent the use of leguminous shrubs and trees where possible. They can grow in soil which would not support other trees, and prepare the land for better trees.

People are poorly nourished and need fruit and ts to supplement the monotonous diet of grain.

The grainyield is always insufficient due to impoverished soil and lack of fertilizer. With drought flood comes famine.

The grain is all needed for human consumption; it is difficult to improve livestock and feed them properly.

The vegetable matter is all taken from the soil and very little is returned to maintain its fertility.

Straw and grass are used for fuel, which also is insufficient for the cold climate.

There is urgent need for hardy trees in such quantity that the branches thinned would supply fuel, permitting the leaves, straw and grass to be used for humus.

In this climate trees are important to protect fields and buildings from drying winds. The lumber production is far below the demand. Importations take large amounts of money out of the country.

Wood of high quality is needed for cabinet work and carving to encourage these industries.

More basket material is needed to make articles used in the home and on

the farm.

Hardy trees and shrubs, once established on the wastelands, would furnish as much fuel by their excess branches as the grass now obtained, leaving some trees to grow wood, and also give numerous indirect benefits to China.





